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W. W. CHARTERS, *Editor*
J. MACLATCHY, *Assistant Editor*

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EDUCATIONAL RESEARCH BULLETIN

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COLLEGE OF EDUCATION
THE OHIO STATE UNIVERSITY

Vol. XI, No. 1

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(Entered in the United States Patent Office)

W. W. CHARTERS ..... *Editor*
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Ability to Use Scientific Method

By RALPH W. TYLER

One of the most difficult problems in the construction of achievement tests is the development of objective examinations which will measure the student's progress toward the wide range of important educational objectives. A rather high degree of skill in testing the amount of information which a student possesses has already been attained. Methods have been developed by which these tests of information may be made objective and highly reliable. Unfortunately, the same degree of development has not taken place in the measurement of other objectives. To develop examinations which might be used in determining the progress of students toward a variety of educational objectives is the purpose of the work being carried on with a number of subject-matter departments of Ohio State University. The general procedure followed in constructing these examinations has been described previously.[1] Certain of the new examinations will be described in more detail in this paper.

One of the objectives considered important by every science department in the University is "to teach students to use scientific method." The instructors in these departments believe that their courses should train students who are able to go beyond the information and opinions of the day and, by applying scientific method to new problems, to gain new knowledge. Because this is considered such an important objective it is exceedingly necessary that examinations be used which will indicate whether or not the students are actually attaining this goal. Such examinations to be good tests should be as valid, as objective, and as reliable as possible.

The first step we have used in constructing an examination

[1] Tyler, R. W. "A Generalized Technique for Constructing Achievement Tests," Educational Research Bulletin, X (April 15, 1931), pp. 199–208.

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for a given course has been to define each objective of the course rather specifically in terms of student behavior. The next step is to collect situations in which the students will have an opportunity to express this behavior. These situations can then be used as the preliminary test situations. The assumption involved in this method is that the student's behavior in a sampling of these situations is an index of the degree to which he has attained the desired objective. Thus, for example, if the objective is "ability to use the microscope effectively in botany," we would collect a number of situations in which the student would be expected to use the microscope, we could present these situations to the student, and the degree to which he was able to use the microscope effectively in these test situations would be an index of his general ability to use the microscope in botany.

When this method is applied to the objective "ability to apply scientific method" it is first necessary to analyze this objective in terms of the student behavior desired. When this has been done by the instructors in the departments concerned, we find at least three types of student behavior involved in scientific method. The first of these is the ability to formulate a reasonable generalization from specific experimental data. The second type of behavior is to plan an experiment which could be used to determine whether or not a proposed hypothesis is true, and a third type of behavior is to apply general principles to concrete situations. A valid test of the student's ability to use scientific method must then consist of situations which require the student to do these three sorts of things.

After the objective has been defined in terms of specific student behavior, we must collect samples of situations which could be used for the examinations. This means for the first type, a collection of situations which requires a student to draw reasonable generalizations from specific experimental data. In botany, for instance, such exercises as the following are examples of these test situations:

A number of barley plants were grown in soil low in nitrates. It was found that the tops weighed five times as much as the roots. At the same time similar barley plants were grown in a soil containing an abundance of nitrates. In this case the tops weighed nine times as much as the roots.

A coleus plant exposed to full sunlight became green. A similar coleus plant exposed to only red rays of light became green. A similar

coleus plant exposed to only orange and yellow rays of light became green. A similar coleus plant exposed to only green rays of light became green. A similar coleus plant exposed to only blue-violet rays of light became green.

When a number of tobacco plants were grown in the sun, it was found that the average dry weight of each plant was 31.4 grams, the average amount of water absorbed from the soil by each plant was 7.7 liters, and the average amount of salts absorbed from the soil by each plant was 3.04 grams. When similar tobacco plants were grown in the shade, it was found that the average amount of water absorbed in the soil by each plant was 6.0 liters, and the average amount of salts absorbed from the soil by each plant was 3.51 grams.

These are samples of test situations collected by Professor Sampson, of the Department of Botany. The students were asked to read each exercise and then to write beneath it the generalization which they thought could most reasonably be made from the data given. Similar exercises were developed by other science departments. It is obvious that these are quite different from the usual information type of examination questions. The essential facts are given to the student; the test determines whether he is able to relate these facts and to draw a reasonable generalization from them.

After such an examination has been given an important question at once arises. Can the answers be graded with any degree of objectivity? If instructors vary widely in their grading of any particular answer, it is clear that the scoring of such an examination is so subjective that the results may be of little value. In a previous article, the writer describes an experiment in which the scoring of these answers was tested. It was found that when the answers were evaluated independently by each instructor the average of the ratings given any answer by three instructors chosen at random was almost identical with the average rating given the answer by all the instructors in the department. In no case did the evaluation of any question by the three instructors differ more than .3 from the average evaluation of all the instructors.[2] It is apparent then that these answers can be graded by three instructors so as to give results which are almost identical with those obtained by having the members of the entire department evaluate the student's

[2] Tyler, R. W. "Measuring the Ability to Infer," EDUCATIONAL RESEARCH BULLETIN, IX (November 19, 1930), pp. 475–80.

responses. This indicates that although to determine how well a student has drawn a reasonable inference from specific data is a matter of judgment, this judgment is not wholly subjective varying widely with individual biases, but rather it is exact enough to yield a fairly accurate score for each student.

THE question, Why were the test exercises not set up in a multiple-response form? may be asked, for the scoring of such a test is wholly objective. The behavior to be measured, however, is the student's ability to formulate for himself a reasonable inference, so that a test which requires him only to select the best inferences from a given list cannot be used unless we can show that this latter type of test is highly correlated with his ability to formulate his own inferences. After we had found that the students' answers could be scored with some precision, a test of the type described was constructed containing so large a sampling of test situations that its reliability was .94. Using this test we wished to find out whether a simple multiple-response test would give identical results. The procedure followed was first to give the test requiring students to formulate their own generalizations. These papers were taken up, and the students were given the same test situations, but, instead of being asked to formulate their own generalizations, a series of five possible generalizations followed each test exercise. The student was asked to check the best generalization of the five. This multiple-response test was scored, and the results correlated with the results obtained from the original test giving a coefficient of correlation of only .38. Hence, it was clear that this multiple-response test could not be used in place of the original test which required the students to formulate their own generalizations. Nevertheless, it is desirable to try to construct a valid test which can be scored more easily. Since the original test requires careful grading by three instructors, which is likely to discourage some departments from using that method of examination extensively, we have been experimenting with other more practicable methods of measurement.

A new test was constructed in which the alternatives used were arranged from those generalizations which have actually been proposed by students who took the preliminary examination. Each test situation was followed by five of these student responses. The student was asked to check the generalization

which he thought was the best and also the one which he thought was the poorest of the five. This new test was scored by giving the student a credit value for each alternative checked as the best and subtracting the credit value for each alternative checked as the poorest. This credit value was the mean rating given that generalization by the three instructors who had evaluated the student's answers. His response for each item then was not counted as either right or wrong, but his score might be anywhere from 5 to −5. This new test was administered to a new group at the same time that the original test requiring the students to propose their own generalizations was given. The scores on the new test were correlated with the scores on the original test giving a coefficient of .85. This new test then has much higher validity than the simple multiple-response test and is much more practicable than the preliminary examination.

UP TO this point I have been describing the development of an objective method of testing the ability of the student to draw generalizations from specific data. The second type of behavior involved in scientific method is to plan experiments to determine the truth or falsity of certain hypotheses. A student who has been trained in botany, for example, when asked whether ultra-violet rays stimulate the growth of vegetative organs of the plant should be able to say how the answer to this question might be found out; that is, he should be able to plan experiments which would determine whether or not ultra-violet rays do stimulate the development of vegetative organs in a given plant. The proper test situations for this type of behavior are hypotheses which have not been tested or which elementary students would not know about before. In connection with each such hypothesis, the student would be asked to describe an experiment which could be used to determine whether or not this hypothesis were true. As examples of hypotheses, these have been used by the Department of Zoölogy.

1. The hibernation response of the frog is the result of low temperature and not the particular season of the year.
2. Temperature of the external atmosphere affects the rate of heartbeat in the frog.
3. Lizards breathe through their skins as well as through their lungs.
4. The action of ptyalin in changing starch to sugar is most rapid at 80 degrees F.

Similar tests situations were developed in other science subjects. It was found that reports of recent research studies which indicated the problems yet unsolved constituted an excellent source for hypotheses which have not already been tested and which would require the students to use their own originality in planning appropriate experiments.

These tests were administered by presenting the hypotheses to the students and asking them to describe an experiment which could be used in testing these hypotheses. As in the case of the generalization, the student's answers were typed upon cards and evaluated by each instructor independently. In this case, too, it was found that the evaluations were so much alike that the mean ratings of any three instructors chosen at random could be used to represent the ratings of the entire group of instructors.

After developing this rather exact method of grading the answers, enough exercises were chosen to make an examination which had a reliability coefficient above .90. We then attempted to construct an examination which would give results similar to those obtained when the students were asked to plan original experiments yet which might be scored easily and administered quickly. Following the suggestion of the generalization tests, a number of the experiments proposed as answers by students who took the original examination were selected as alternatives for a multiple-response test, consisting of a series of hypotheses each of which was followed by a description of five possible experiments. The student was asked to check the experiment he thought the best to find out whether the hypothesis was true and the one which he thought the poorest. This test was administered to a new group at the same time as the one in which the student was asked to formulate his own experiment. The correlation between the two tests was .63. This means that the multiple-response test gives somewhat similar results to those obtained by the original test but hardly close enough so that one could be used entirely in place of another.

NEXT, we experimented with a multiple-response test constructed in the same way that one mentioned in the preceding paragraph was built; that is, a number of experiments which had been proposed as answers by a group of students were selected as alternatives for the test which consisted of a

series of proposed hypotheses each of which was followed by a description of five possible experiments. In this case, however, the student was asked to mark with the figure *1*, the experiment which he thought the best way of verifying the hypothesis, with the figure *2* the second best, with a *3* the third best, with a *4* the fourth best, and with a *5* the poorest. This test was administered to an entirely new group at the same period but immediately after the students had been given the test in which they were asked to formulate their own experiments. The correlation between these two tests was .79. This means that this new test gives results still closer to those obtained by the original test. We are still experimenting upon other methods of examination with the hope of finding a simple and easily administered method of measurement which will give even more valid evidence of the ability of the student to plan an experiment to evaluate an hypotheses. Until such a device is developed, we shall continue to use for a portion of our measurements the original method of having the student propose his own experiment and to evaluate the answers by three or more instructors independently.

A THIRD aspect of scientific method is the ability of the student to apply principles to new situations. To develop such a test requires the formulation of a set of important principles taught in the given science subject. After this has been done we are ready to collect situations which require the student to apply one or more of these principles. In the case of principles which involve definite mathematical relationships, the application of the principle requires the solution of a mathematical problem as in the case of applying Boyle's Law in physics or chemistry. There is nothing new in testing mathematical principles in this fashion except that we can separate the measurement of the student's memory of the principles from his ability to apply them by providing for the memory questions in the first part of the test, then taking up these papers and giving the student a list of the important principles, together with a series of situations requiring the student to apply the principles. The student shows his ability to apply mathematical principles by solving the mathematical problems. For principles that are not mathematical in character, the student shows his ability to apply them by formulating an explanation of the

specific situations given in terms of the general principles which have also been given him. These explanations can then be evaluated by several instructors independently as was done with the other exercises.

This test may be set up in much more objective form by asking the student to write below the situation the numbers of the principles given in the accompanying list which explain the situation described. An example of this sort of test is the following prepared by D. F. Miller, of the Department of Zoölogy.

EXPLANATION TEST

Directions.—Each of the following exercises consists of a statement of an observed fact. You have been given a list of important zoölogical principles which have been treated in the course. You are asked to read the observed fact, and then explain it by selecting the principles from the list which help to explain the fact. List the numbers of the principles in logical order below the fact as in the sample.

SAMPLE

Statement.—A person in an anaemic condition, that is, with a deficiency of red corpuscles in the blood, is not usually physiologically active.

3, 12.

Principles.—Note that if principles 3 and 12 are read in order, one gets a logical explanation for the inactivity of the anaemic person. Remember to select the principles which help to explain the statement. Then write the numbers of these principles in logical order so that reading the principles in the order you have listed them will give a logical explanation.

EXERCISES

a. Salivary digestion is not as effective in an acid mouth as in one which is alkaline.

b. Two animals of the same size and kind are fed upon the same quantity of food although the food is different. One animal excretes 2 grams of urea per day, while the other excretes 40 grams.

Along with these exercises the student is given a leaflet in which the important principles of the course are stated and numbered to facilitate reference. The results of this latter test were correlated with those in which the student formulates his own explanation from the principles given. The coefficient of correlation of .87 thus obtained indicates that the second type of test gives almost identical results with those obtained by the first type. Since this second test can be easily administered and

is objectively scored it is feasible to use it as a fairly valid measure of the student's ability to apply principles.

PERHAPS the foregoing is a sufficient description of the methods used in developing a series of tests to determine how well students have learned to apply scientific method. It is apparent at once that the construction of such achievement tests in Ohio State University is a co-operative enterprise. No test technician alone, unless he is an expert in the field of subject-matter, can construct achievement tests which are certain to be valid. The members of the department concerned are ultimately responsible for the examinations. The significant fact about the construction of these examinations is that the ultimate criterion of their validity is whether they require of students the behavior which has been set up as the goal of instruction. Any simplified and easily scored tests are validated by correlating them with the original tests which measure the desired behavior directly.

In summarizing, may I say that the results thus far obtained justify the belief that scientific method may be measured directly with some degree of precision even though the task of scoring the answers is time-consuming and a bit tedious. In cases where it is desirable to use easier and more practicable methods of testing, types of tests have been developed which give results corresponding quite closely to those obtained from direct measurement as a means of determining the student's ability to formulate generalizations from specific data and his ability to apply general principles to concrete situations. We have not yet developed a wholly satisfactory simple device for testing the student's ability to plan experiments for testing hypotheses which correspond closely with the direct method. This is a problem upon which we are still working.

An Analysis of State School-Building Codes

By H. M. McGOWAN[1]

In a recent number of the BULLETIN, the provisions found in state school-building codes which apply to the location of the school buildings, size and method of acquiring the site, approval of plans, and the percentage of the lot that might be occupied by the building were presented.[2] Other code provisions relating to other phases of the problems are included in the material which follows.

Three states, Delaware, Ohio, and Minnesota, classify their school buildings. Delaware uses the classification of the American Institute of Architects which ranges from "A" to "E," the "A" being a strictly fireproof building and the "E" a frame structure. Minnesota uses the classification of the National Board of Fire Underwriters which recognizes three types, frame, non-fireproof, and fireproof, while in Ohio, school buildings are divided into two classes, "A" and "B," the former housing pupils below the age of eighteen, and the latter, above.

Thirty-two states have no requirements on kinds of construction, while the requirements of the remaining twelve are so different that comparisons can hardly be made. The statutes of Tennessee, Utah, and Wisconsin describe in detail both the material to be used and the method of construction.

The use of brick or other impervious material for construction above the grade line appears six times, the largest number of any specification. The stipulation that the first-floor level should be from three to five feet above ground level appears five times. Among the other requirements, appearing three times or less, are the following: foundations of brick are necessary for one-room schoolhouses, buildings shall be designed to meet future expansion, the building is to be not more than two stories in height, chemistry laboratories are to be on the top floor, the minimum width of stairways and corridors are stated, supporting walls are to be built of hollow brick, the first-floor level must not be more than ten feet high, the walls are to be waterproof and wooden floors laid double.

[1] T. C. Holy, Bureau of Educational Research, Ohio State University, adviser.

[2] McGowan, H. M. "An Analysis of State Building Codes," EDUCATIONAL RESEARCH BULLETIN, X (November 25, 1931), pp. 458–61.

Three states, Ohio, Pennsylvania, and Wisconsin, have made statutory requirements in regulating courts, all of which are to be for the purpose of providing adequate natural lighting for the classrooms bordering the court. As an illustration of these regulations, the Ohio Code prohibits the covering of a light court by skylight, roof, or other obstruction.

State regulations governing the fire provisions in schoolhouse construction have been more extensive than any other item found in school-building codes. Sixteen states, however, make no such provision. Of the thirty-six states which do, there is a striking similarity in their content. For example, twenty-four states require that all exit doors shall swing outward, and eight of these states specify that the hardware on these doors be panic bolts or their equivalents. The statutes in five states, Connecticut, Maryland, New York, Ohio, and Wisconsin, provide that school buildings two stories or more in height shall be of fireproof construction. The fact that so few of the states have such a provision probably accounts for the rigid requirements for adequate fire escapes in twenty states.

Other fire provisions found in the codes together with their frequency are as follows:

Provision	States Number of
Doors to open out	25
Panic bolts on exit doors	8
Fireproof construction of two-story building	5
Two-story building equipped with fire escapes	19
Two-story building may be semi-fireproof	3
Fire gongs provided	6
Two exit doors required	12
Doors not to open on stairways	9
Width of stairways designated	9
Height of riser, 6.5 by 8 inches	7
Width of treads, 10 by 12 inches	7
Substantial handrail	7
No dead ends to corridors	2
Width of corridors, 4 by 12 feet	7

Six states, Arizona, Minnesota, New Jersey, Ohio, Utah, and Wisconsin, define basement rooms and designate the type of construction. None of these allows any except laboratory and physical-education classes to be held in basement rooms.

The importance of lighting is recognized by fifteen states. In all, there are twenty-five different legal requirements on

classrooms. Many states have indicated certain requirements for the classrooms:

Specified number of cubic feet of air space per pupil. Twelve of these states require 200 cubic feet	Arizona, Connecticut, Delaware, Idaho, Indiana, Maine, Montana, Nebraska, New Jersey, New York, North Dakota, Oklahoma, Pennsylvania, South Carolina, Utah, and Virginia
Amount of floor space per pupil, which amount varies from ten square feet in Kentucky to nineteen in New Jersey	Connecticut, Delaware, Kentucky, Maine, Michigan, Montana, Nebraska, New Jersey, New York, North Dakota, Oklahoma, Pennsylvania, South Carolina, South Dakota, Texas, Virginia, and Wisconsin
Statutory provisions for the arrangement of the furniture	Minnesota, Ohio, Wisconsin, and Texas

Provisions for providing fresh air and comfortable temperature in schoolrooms have been specified in part by thirty-one of the states. The temperature to which the rooms are to be heated is specified by Arizona, Connecticut, Delaware, Idaho, Indiana, Minnesota, Nebraska, New Jersey, Ohio, Pennsylvania, South Dakota, Tennessee, Texas, and Utah. Fifteen states also make provision on the number of cubic feet of air per minute which must be delivered to the classrooms, with the exception of Delaware, which requirement is thirty cubic feet per minute. One state, Kentucky, permits the heating of classrooms by fireplaces. The capacity, size, and location of exhaust vents for the removal of foul air are mentioned in eleven states, but only five of these make definite specifications.

Twenty-eight states make some statutory provision for

sanitation.[3] Thirteen states prohibit the use of the public drinking cup in the schools, while only nine require that pure water be provided for the pupils during school hours. Ten states prohibit the placing of drinking fountains in toilets. In school districts where inside toilets are provided, the number of toilet seats and of urinals has been stipulated in Delaware, Maine, Maryland, Minnesota, Ohio, Tennessee, Utah, and Wisconsin. Other sanitary provisions relate to the construction of toilets, washbowls, and general conditions.

Only three states, Ohio, Pennsylvania, and Wisconsin, make provisions for artificial lighting. Ohio provides for both gas and electric fixtures, while Pennsylvania and Wisconsin provide for electric fixtures only. The lighting provisions of Ohio and Pennsylvania conform to the National Electric Code; those of Wisconsin conform to the Wisconsin State Electric Code.

IN ORDER to have some measure on the degree of conformity between generally accepted standards for elementary-school buildings as expressed in a score card, the code requirements of the forty-eight states were checked against each item on the Stevenson-Ashbaugh Score Card for Elementary School Buildings which contains 224 different items. These items were arranged in a table in column form with the states in order across the top. Check marks were made in the case of states having statutory provisions relating to any of the items in the score card. If all of the forty-eight states had requirements on each of the 224 items, there would have been 10,752 entries. There were, however, but 231, or slightly more than 2 per cent of the maximum number. In other words, when all the states are taken, there are statutory provisions relating to but 2 per cent of the items appearing in the Stevenson-Ashbaugh score card. This score card, as do others, emphasizes provisions for cloakrooms; special classrooms; rooms for general use, such as auditorium, libraries, and lunchrooms; rooms for officials, and such special rooms as laboratories and shops. On these items, there are no significant legal requirements.

The greatest similarity between legal provisions and score-card items is in the requirements for heating and fire protection,

[3] These are, Alabama, Arizona, Colorado, Connecticut, Delaware, Idaho, Illinois, Indiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Nebraska, New Jersey, New York, North Dakota, Ohio, Oklahoma, Pennsylvania, South Carolina, South Dakota, Tennessee, Texas, Utah, Virginia, West Virginia, and Wyoming.

water supply, size and number of rooms, and illumination. No one statute agrees with the score card more than twenty-four times. The statutes make few requirements on the location, size, or form of the site, or gross structure of the building. Service systems, outside of fire escapes and water supply, received little mention in the building codes. It is evident from the analysis which has been presented, that either legal requirements or administrative authority should be set up so that the characteristics of school buildings and equipment deemed essential by the people who must use them can be secured.

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Evaluating Courses

By R. H. ELIASSEN

COURSES that had direct application to teaching situations were rated by one thousand Ohio State University graduates as those which were most valuable to them in their teaching. The graduates stated that beginning teachers derived most benefits from courses that acquainted them with actual problems which they later met in the field, together with a knowledge of approved techniques for meeting such situations. These one thousand graduates of the College of Education, Ohio State University, representing five graduating classes 1925–29, were asked to rate the required educational courses in retrospect.[1] The instructions to them were worded as follows:

> Please rate the courses that you have taken at Ohio State University according to the values that you have received from them as applied to your work as a teacher. Use the rating scale of 0–5. Zero is to indicate no value received, one will designate very little usefulness, and five the most helpful course. In judging, consider primarily the general all-around professional value of the course.

Graduates are not always the most competent judges of the values derived from their education. They are in many cases unable effectively to determine their own limitations and the extent to which these may be due to faulty training. They

[1] Eliassen, R. H. "A Follow-Up Study of Ohio State University Graduates from the College of Education, 1925–1929." 1930. An unpublished Doctor's dissertation on file in the library of Ohio State University.

sometimes are unable to discriminate between the characteristics of pre-service and in-service trainings. Then, too, some of the graduates tend to forget what they obtained from the various courses. A technique similar to the one used by Peik in which the graduates ranked specific topics rather than the subjects in general[2] might have minimized the influence of forgetting. The purpose of this rating, however, was primarily to get the general reactions of graduates to the various required courses when they can look back at them in perspective. The average of the rankings assigned by these students were as follows in the order named:

	Ranking
Special Methods	4.1
Observation and Methods	4.0
Supervised Teaching	3.8
Educational Psychology	3.4
Principles of Education	2.9
Administration of Pupil Personnel	2.7
Elementary Psychology	2.5
Fundamentals in School Administration	2.4
History of Education	1.8
Survey of Education	1.0

On the basis of five as a perfect rating, it is noted that Special Methods received the highest average rank with a rating of 4.1. Survey of Education which is an introductory orientation course offered to Freshmen was given the lowest rating. There is a range of 3.1 between the ratings given for the two courses. The comparative rankings of College-of-Education courses in terms of general value ascribed to them by graduates of the universities of Minnesota and Ohio State are:

Rank Order	Peik's Findings	Ranking of Ohio Graduates
1	Practice Teaching	Special Methods
2	Special Methods	Practice Teaching
3	Educational Psychology	Educational Psychology
4	Techniques of High-School Instruction	Principles of Education
5	High School	School Administration
6	Educational Sociology	Elementary Psychology
7	History of Education	History of Education

Peik in his study made separate analyses for practical values, theoretical values, and general values. The ranking in terms of general values are presented in the lists just given. To facilitate

[2] Peik, W. E. *The Professional Education of High School Teachers.* Minneapolis, Minnesota: University of Minnesota Press, 1930.

comparisons the Ohio list of rankings was consolidated. Aside from slight variations in subject-matter terminology, the two lists agree strikingly. Practice Teaching and Special Methods rank first or second in both lists with Educational Psychology in third place. History of Education was comparatively low in both investigations.

IN ORDER to test the extent to which the marks received in the particular subjects affected the ratings of the courses, a trial test was made with School Administration 601 (Administration of Pupil Personnel). The ratings for all the individuals who evaluated the course were secured, and these were studied in terms of the marks secured. The students who received low marks rated the courses high almost as often as did those who received better marks. On the other hand, the people who were leaders in the classes rated the subjects low about as often as did those who barely passed the courses. One cannot generalize from this one study and say that marks do not affect the ratings of subjects to any marked extent, but it was true for this one subject.

The graduates were also asked to express their reactions to the various courses, and the criticisms thus secured were what one would expect. Mention was made of the unnecessary duplications in text materials, the lack of practical applications, and the failure to adapt the subject-matter to the needs and capacities of students. A frequent criticism made was that some courses could and should be made more practical. Theoretical and historical courses as a whole were frowned upon, but there were a few students who championed the cultural and thought-stimulating values derived from the study of Principles of Education and History of Education.

Many of the graduates referred to the teaching personalities of their instructors. Fine tributes were paid to some professors, while others were subjected to criticisms because of their attitudes toward students and unproductive methods of guiding learning. It is undoubtedly true that the ratings of the courses were more or less affected by the personalities of the college teachers. This does not mean, however, that the courses that rated low necessarily had the poorest teachers, because it was often indicated that the only redeeming feature of some of these

[*Continued on page 26*]

EDITORIAL COMMENT

Radio Education

THAT the American public is interested in adult education by radio is demonstrated again by the recent series of addresses presented through the National Broadcasting Corporation chain by the National Advisory Council on Radio in Education.

The Council during the year has organized committees of psychologists and economists to prepare a series of thirty addresses in each field to be given once a week, and the National Broadcasting Corporation has agreed to provide the necessary time and facilities for broadcasting. The programs have now been on the air long enough to show by the evidence used to measure radio popularity that these two series are outstanding hits. Fan mail of huge proportions has been received by the stations. Eighty-five thousand copies of the addresses have been sold within two months to individual listeners who wish to study further what they have heard in the broadcastings. Over twenty thousand notebooks and reading guides were likewise sold to people in practically all of the states of the nation.

These figures provide an indication of the presence of an intelligent American audience of large extent whose existence would not be suspected from the fan mail of the common amusement programs of the commercial broadcasters. Some college stations have been touching this stratum for years in their local areas and a special series of chain programs in music, foreign relations, and the like have met with cordial responses.

This new series, however, is especially significant because the programs are given by scholars outstanding in their fields and with no attempt at showmanship. It will astonish the pessimists who doubt the existence of intelligent audiences in a democracy to discover a "sell out" of the erudite addresses of Dewey, Butler, Angell, and Woodworth in the psychology series and of Bogart, Moulton, and Leiserson in the economics series.

This establishes one conclusion, clearly. The best scholars in the nation, using their customary vocabulary, conscious of the fact that they are speaking to laymen, and discussing the broad

principles of their specialties, may expect to find hundreds of thousands of American laymen who will listen to them with interest and understanding.

Nor is this interest confined to any one educational level. Laymen of all vocations are represented in the mail—farmers, stenographers, engineers, students, accountants, bankers, and housewives. In every walk of life are found individuals who wish to learn more about those mysteries of knowledge which the scholars can explain.

The radio brings the scholar to the door of every home and introduces him to the members of the household to whom he may sell his wares. Upon acquaintance the audience becomes interested. No other medium of communication—books, newspapers, magazines, or public addresses—can provide an introduction equal in power and breadth of audience to that which is furnished by the radio.

Education must become radio-conscious.

W.W.C.

* * *

AVIATION is taught both day and night in the Burgard Vocational High School, Buffalo. The intricacies of actual plane construction, repair, and even flying are studied in six new aviation workshops by 150 day students and 250 evening students, according to a report to the Federal Office of Education by William B. Kamprath, principal of the school. Supplied with actual planes and plane engines and equipment such as is used in the service departments of modern airplane repair hangars, the Burgard students are granted an exceptional opportunity to learn almost everything about aviation from aircraft construction to air navigation.

The courses extend over a four-year period. Students spend one-half of every day in the aviation workshops. The other half of the day is spent in studying regular high-school subjects including related trade work in science, mathematics, and drafting. Shop and laboratory work includes construction and repair of aircraft, repair of aircraft engines, aircraft machine shopwork, aircraft electrical repair and welding, aerodynamics, meteorology, and air navigation.

READINGS

THRASHER, FREDERIC M. "Research Problems in School-Community Relationships," *Journal of Educational Sociology*, V (November, 1931), pp. 178–87.

The author stresses the point that the school-community relationships which best achieve the purposes of education and social efficiency must be discovered through scientific research rather than armchair theorizing. Facts are necessary to supplant our impressions in generalizing about public-school relations. The need of such information is evident. Eleven specific problems are presented for study. Students and others interested in research in the field of educational sociology will find it a suggestive source for research problems.

BRIGGS, THOMAS H. "Jeremiah Was Right," *North Central Association Quarterly*, VI (December, 1931), pp. 272–82.

Mr. Briggs criticizes American education on the score of nebulous and ineffective aims, inadequate and impotent research, and piecemeal attempts to reform the curriculum. He advocates that exceedingly popular method of reform—a national planning commission. Mr. Briggs devotes nine pages to delineating points of weakness and about a page and a half to the description of the plan for this national commission. It is hoped that he will consider it his duty to develop a more adequate description of his plan, including therein the administrative set-up, suggestions for personnel, a proposed ten-year program of work, and a tentative budget.

HENZLIK, F. E. "The Small Town Superintendency as a Future Career," *School Executives Magazine*, LI (December, 1931), pp. 154–55, 178.

Because of the introduction of electrical devices, good highways, and improved machines the small town is attracting people of higher social standing who are requiring more competent men as superintendents, and who are elevating this position. These superintendencies offer a challenge and a career to broad-visioned, courageous persons who have initiative and faith in education.

DUNBAR, RALPH E., AND GRANDY, IRVING J. "Chemistry Tests Available for Use in High School Classes," *School Science and Mathematics*, XXXI (December, 1931), pp. 1100–1102.

Chemistry teachers are often searching for tests in this subject. The article presents a bibliography of fourteen sets of tests in chemistry. The price, publisher, and description of each test are given. No information, however, is given concerning the validity and reliability of the tests.

DUNKELBERGER, GEORGE F., AND RUMBERGER, ELDON K. "Who Are the Voters?" *Journal of Educational Sociology*, V (November, 1931), pp. 159–61.

It is interesting to obtain some evidence as to who does the voting in these United States. Representative groups of voters in five different counties

of central Pennsylvania were studied and were classified according to their occupation or profession. The classification consisted of five groups: professional men, business men, clerks, skilled laborers, and unskilled laborers. The results show that about one-half of those who register come out to vote. The percentage of the registered citizens who vote consistently increases as we go along the classification from unskilled laborers to professional men. Since there is this high positive relationship between education and good citizenship as shown in the exercise of the suffrage right, the authors enter a firm plea for adult education. "What is needed in a democracy is a program of education that includes everybody, adults as well as children."

SHIPP, FREDERIC T. "Social Activities of High School Boys," *School Review*, XXXIX (December, 1931), pp. 767–74.

The writer presents data secured from a questionnaire given to several hundred students in the San Jose senior high school. These data relate to the participation of the boys in dancing, parties, going out with girls, movie attendance, and use of automobiles. It is interesting to see that 56 per cent of the boys attend motion pictures once a week or oftener.

SCHAFFLE, ALBERT E. F. "The Pupil Checks the Teacher," *School Executives Magazine*, LI (December, 1931), pp. 151–53.

Educators fail to give enough credit to opinions of secondary-school and college folk regarding the qualities of their instructors. The results of two student-rating studies are included in this article and the opinions of many teachers as to the use of such ratings are "aired." The shoe fits so snugly that the teachers dislike wearing it, but "no one knows a teacher as well as her pupils."

KEMMAN, RUTH H., AND LEWERENZ, ALFRED S. "The Relation of Intelligence to Movie Attendance of 254 Eleven-Year-Old Pupils," *Los Angeles Educational Research Bulletin*, XI (November, 1931), pp. 36–39.

The author in a previous study had reported that among unselected elementary-school pupils the older and duller pupils attended the movies most frequently. The study reported in this issue was undertaken to determine whether there was any relation between movie attendance and intelligence quotient for children of the same age. The eleven-year-old pupils in three of the better school districts reported movie attendance during the previous week and previous month. These reports were used as the basis of the study. It was found that the correlation between the intelligence quotients and times of attendance for these children was only .06 indicating little relation.

REED, MARY. "Some Reading Experiences," *The New Era in Home and School*, XII (November and December, 1931), pp. 382–86, 415–18.

A program of teaching reading for the kindergarten and first three grades in the Bronxville schools in which reading was a part of the purposeful activities of the children is described in this article. A vocabulary was acquired through context rather than through rote learning. The children learned to read by reading. The reading experiences in the kindergarten and early first grade came from use of bulletin material, notices, and other writing which

could be utilized in their group activities, such as excursions, construction interests, and other group projects. In the second and third grades the "story hour" provided opportunities for the children to read to one another. Although the urge for both oral and silent reading came from the activities of the group, considerable individual attention was given to slow readers through pointing out phonetic elements and through individual drill.

In Paper Covers

MONROE, WALTER S., AND ENGELHART, MAX D. *Experimental Research in Education.* Urbana, Illinois: University of Illinois, 1930. 105 pp. (University of Illinois Bulletin, XXVII, No. 32)

Research workers, students, and those who are reading the results of educational research have welcomed this critical volume dealing with the essential characteristics for experimental research. The authors describe the requirements for a controlled group experiment, emphasizing the importance of controlling all factors which are likely to affect the results of the experiment. They point out that this has rarely been done, but unfortunately no methods are suggested by which the adequacy of controls can be checked empirically. They do list, however, various factors which probably need to be controlled in careful experimentation. An excellent discussion of the interpretation of differences resulting from controlled experimentation is also included. This chapter is of particular value in making allowances for various types of errors in measurement commonly found in such studies. The authors apply their criteria for controlled experiments to the experimental studies relating to supervised study made in previous years to show how few of these criteria have been adequately met. The concluding chapter lists some of the problems to be solved in using experimentation as a procedure in educational research. This bulletin can be read with profit by everyone interested in the results of educational research.

RALPH W. TYLER

RADTKE, BRUNO. *Some Observations on German and English Education in Elementary and Secondary Schools.* Lawrence, Kansas: Bureau of School Service and Research, University of Kansas, 1931. 36 pp. (Kansas Studies in Education, Vol. II, No. 1)

Since the World War, interest in education has been increasing considerably in Germany and England. The people of these countries are firmly convinced that the way out of a terrible political, social, and economic crisis is through education. The changes in German education have been more revolutionary than those in England. Germany has established a uniform state-school system under government control in which the democratic principle of equal opportunities for all citizens is emphasized. Scholarship ranks first, and intellectual capacity is the decisive factor in the pupil's school career. A radical reform of teaching methods has resulted in creating the so-called "activity school." Individualistic tendencies are balanced by ideas adopted from the youth movement. Unfortunately, the vigorous development of the reform is badly handicapped by the financial plight of Germany.

The English system shows greater variety and greater independence.

Education of the aristocrats and of the masses is strictly separated. Overproduction of intelligentsia is not encouraged. Careful selection is made. Character training is one of the most outstanding features of English education. Changes in the English system have been slow and probably will never be made suddenly as in Germany.

The author presents in a clear and interesting style the outstanding features of the educational systems of Germany and England. Being a German it is probably right that he should cover more thoroughly the German system of which he gives a glowing description. His analysis of the English system, while showing a keen insight into and sympathy for the problems of English education, is not as thorough nor as optimistic as that which he makes of the new German system of public education.

W. E. ARNOLD

WESTERN RESERVE UNIVERSITY. *Curriculum Service for School Officers.* Cleveland, Ohio: Western Reserve University. 1931. 7 pp.

This leaflet describes the curriculum laboratory developed by Henry Harap at Western Reserve University. The laboratory is at the disposal of teachers and administrative workers. Consultation service, bibliographies, and printed courses of study are made available. Among the mimeographed materials available for distribution are an annotated bibliography of investigations of curriculum objectives, a bibliography on grade-placement, an outline of the steps of curriculum making, sample units of work in several subjects, a guide to the building of a unit of work, units found in fifteen activity curriculums, and other materials.

EDGAR DALE

ROGERS, JAMES FREDERICK. *The Speech Defective School Child.* Washington: Government Printing Office, 1931. 31 pp. (U. S. Office of Education Bulletin, 1931, No. 7)

Mr. Rogers presents in this government bulletin important information concerning the tragic handicap of defective speech. Such topics as the origin and kinds of speech defects, and the relation of speech defects to sex, age, and mentality are taken up. The main content of the bulletin, however, concerns the special work being undertaken for the children handicapped by speech defects in different cities.

F. H. LUMLEY

UNIVERSITY OF THE STATE OF NEW YORK. *Introduction to the Study of Educational and Occupational Opportunity.* Albany, New York: University of the State of New York, 1931. 51 pp. (University of the State of New York Bulletin, No. 985)

Several schools have been experimenting with orientation courses for junior high-school pupils. So much success has been achieved that it has been deemed advisable to prepare an outline for a course that will acquaint each pupil with his educational and occupational opportunities. The outline has three major divisions: "the pupil and his school," "the pupil and his future," and "the school and the pupil's future." Teachers who are planning orientation courses will find here an excellent foundation for building such courses.

Those who are teaching orientation courses will undoubtedly obtain many helpful suggestions. To the classroom teacher of the regular courses, the pamphlet points out many ideas which can be applied to make his work more efficient.

FRED P. FRUTCHEY

WILSON, ELIZABETH K. *Educational Counseling in High Schools.* Kansas City, Missouri: Department of Education, Kansas City, Missouri, Public Schools, 1931. 13 pp. (Kansas City Service Bulletin, IV, No. 1)

Educational counseling was first introduced in the Kansas City high schools in 1921. During the past ten years the program has developed gradually in response to needs in the various schools. A counselor in each of the four junior and eight senior high schools now devotes at least several periods each day to the work.

Miss Wilson, who is Director of High-School Counseling at Kansas City, has prepared a clear explanation of the need and function of educational counseling. She reviews the changes which have taken place in social and economic conditions that make necessary the help of the school in the adjustment of the pupil to school and to life. A brief explanation of the program, which involves individual and group counseling, is given. In individual counseling the pupil is helped in the matter of preliminary enrollment, changes in program, failures, and personal problems. Group counseling is conducted largely through the home-room organization, school clubs, parent-teacher associations, and departmental meetings.

W. E. ARNOLD

Books to Read

JUTTA, SISTER MARY. *School Discipline and Character.* New York: Bruce Publishing Company, 1930. 324 pp.

This is a readable book for the classroom teacher. Wide use is made of the literature on school discipline and character development. The text includes a comprehensive bibliography with annotations of a large number of the more important titles. The profusion of illustrative cases and autobiographical paragraphs written by children produces both greater interest and greater clarity. The book smacks of the advantages that accrue from first-hand contact with juveniles.

W. W. CHARTERS

NEULEN, L. N. *Problem Solving in Arithmetic.* New York: Teachers College, Columbia University, 1931. vii+87 pp. (Teachers College, Columbia University, Contributions to Education, No. 483)

The purpose of this study is: to analyze courses of study in order to discover what constitutes current practice in the grade-placement of problems with respect to the number of steps involved; to determine the ability of beginning pupils in Grades III to VII, inclusive, to get correct answers to written problems involving one, two, three, and four steps; and to determine the relationships between problem-solving ability and reading ability, computational skill and intelligence. The analysis of courses of study was made in the usual manner and the grade-placement of the several types of problems

was found to be quite variable. To answer the second question three sets of tests were given to more than two thousand pupils in two city school systems. The first set of tests related to problem solving. The second was an inventory of the exact computational exercises required in the solution of the problems in the first test. After drill had been given on the weaknesses disclosed by the inventory test the first test was repeated.

The statement of the results of the tests are not in accordance with the figures of the table on which they depend. Part of this statement is followed by a footnote which directs the reader to look on page 94a for a modification, but page 94a does not appear in the monograph. The results in the table, however, show that on the final test more than 60 per cent of all the pupils in Grade III and above could solve one-step problems correctly. Sixty per cent of the third-grade pupils could also solve two-step problems correctly, but only 48 per cent of the pupils in Grades IV and V could achieve this level of attainment. In order to find that 60 per cent of all pupils had solved three-step problems correctly it was necessary to go as high as the seventh grade. The author does not make enough of this table. He offers no explanation of the inconsistency with reference to two-step problems.

The question of relationships is discussed in terms of raw correlation coefficients of the first order. He finds no consistent correlation between problem-solving ability and either intelligence or reading ability, but "there is a decidedly closer relationship between problem-solving ability and skill in computation."

The apparent lack of importance of reading ability and intelligence in problem-solving is so in contrast to current notions and to the findings of other investigations that they need a more adequate defense than the author has given them. They might be due to the fact that the problems in his test were first carefully divested of all reading difficulties and irrelevant elements.

The study is not of value as a final settlement of anything except the status of the grade-placement of different types of problems in current courses of study.

W. J. Osburn

King, Leo Hamilton. *Mental and Interest Tests.* New York: Teachers College, Columbia University, 1931. 124 pp. (Teachers College, Columbia University, Contributions to Education, No. 444)

During the past decade quite a bit of attention has been given to problems of prognosis in education. Most of the prediction has been done by means of mental and achievement tests. King's chief problem is to see if he can better the prognoses at the secondary level by means of adding interest tests to them. After a careful and detailed analysis of various mental and interest tests, the following conclusions were reached: mental tests were fairly effective instruments for predicting individual grades in English, mathematics, and science; they are more effective for predicting performance in English and science than for predicting performance in mathematics. The interest tests are somewhat inferior to the mental tests as indexes of ability, but seem to show rather definite values for differential prognosis. The interest-test items were taken from the personnel record card of the student.

In the verification study in which the regression equation obtained in the

experimental group is used for a second population similarly selected, the author falls into the common error of assuming that covariation is an ample demonstration of the validity of his equations, overlooking, perhaps, the fact that differences in mean value of the predicted scores and the criterion scores of the verification group may be great and the scores still have a high correlation.

The care used in investigating the items of the interest "test" is worthy of mention. In the methods of equating teacher's marks, King has developed a neat device for doing the job of equating. This makes use of the implicit assumption, however, that equal ranges of scores indicate equal variability of scores; also, that the means of the scores are midway between the highest and lowest. In Appendix C the author gives a usable summary of the use of the Doolittle method in the solution of the normal equations, demonstrating how this particular method can be effectively applied to problems in multiple correlation.

HAROLD EDGERTON

ALLEN, CLINTON M., PH.D. *Some Effects Produced in an Individual by Knowledge of His Intellectual Level.* New York: Teachers College, Columbia University, 1930. 98 pp. (Teachers College, Columbia University, Contributions to Education, No. 401)

This monograph of 98 pages is an attempt to answer two questions: "Is it desirable to acquaint students with the result of their mental test?" and "What will be the effect?" These questions have been asked innumerable times in the last twenty years, and many guesses have been hazarded in reply. The number of adults, professional and lay, who have emphatically declared, "No one is going to get me to take one of those intelligence tests," would seem to indicate that the inferiority complex is much more common than even Freud ever suspected.

The author has made a careful study, gathering many data along many lines. His findings do not indicate that there is any general danger in acquainting the pupil with the result of his test, because if the result is good it makes him happy, and if the result is bad he does not believe it anyway. In other words, the child who takes the test never takes the result as seriously as we adults who give the test or who look on. As a matter of fact, it is only those who have low intelligence who might be expected to be troubled by the result of the test, and we overlook the fact that the very condition of having low intelligence precludes their being able to appreciate the meaning of it. Therefore, why worry?

This monograph should quiet all our fears.

HENRY H. GODDARD

ADLER, ALFRED. *The Education of Children.* New York: Greenberg, Publisher, 1930. ii+309 pp.

A series of essays for parents and teachers, this book sets forth the chief practical implications of Adler's system of "Individual Psychology." The note of extravagance which most of us find in other psychoanalytic writings is absent. Indeed, Adler's book is little more than a common-sense compendium.

There is doubtless a place for such literature provided that place is fully

understood. The matter has been adequately stated by Santayana in "Reason in Science."

> When LaRochefoucauld says, for instance, that there is something about our friend's troubles that secretly pleases us, many circumstances in our own lives, or in other people's may suddenly recur to us to illustrate that *aperçu*; and we may be tempted to say, There is a truth. But is it a scientific truth? Or is it merely a bit of satire, a ray from a literary flashlight, giving a partial clearness for a moment to certain jumbled memories? If the next day we open a volume of Adam Smith, and read that man is naturally benevolent . . . we shall probably think this is a truth also, and a more normal and profounder truth than the other. But is it a law? Is it a scientific discovery that can lead us to definite inferences about what will happen?

Alas! in this case not. Admittedly, symptom blends into symptom, and each may lead us to diverse even contrary diagnosis. Individual psychology, Adler tells us, is an art. One must, from a study of each person, seize upon his salient life plan, and when once we understand that, certain principles aid us in arranging his behavior in intelligible relations. But without that intuition, nought is of avail—and here science is of no avail. For all that, I believe that few parents or teachers will read this book without edification; for some the results may be revolutionary.

For the rest, although the translation seems competently done, the present reviewer does not find the style moving, either emotionally or intellectually. There is progress but no sense of progress; it is a series of "stills" rather than a cinematograph.

HORACE B. ENGLISH

* * *

Evaluating Courses

[*Continued from page 16*]

courses was the fact that the professors were inspiring. The factor of teaching personality would undoubtedly have been less prominent if topics instead of entire courses had been the basis of the evaluation.

The findings of this study of the ratings of required courses in education are not conclusive in themselves. Rather they stimulate thought and encourage further study of the problems of curriculum construction in our colleges of education. There is need for scientific evaluation of the curriculum through the co-operation of all departments. A thorough study of the curriculum of the College of Education, Ohio State University, is being carried on at the present time by a committee headed by R. D. Bennett and directed by W. W. Charters. It is hoped that the resulting curriculum will meet the major criticisms expressed by the graduates who are in the field.

NEW TESTS

With changes in examinations and the use of point scores, the task of assigning marks to pupils has come to be recognized as much less simple than it formerly was thought. As long as the percentage mark ruled the thought of teachers, the task of giving and marking the examination was the tedious job, marks were easily assigned on the basis of the percentage score received in the examination. Now, with the recognition that test exercises may vary widely in difficulty and the further realization that brighter pupils may be better tested by examinations of sufficient range to allow opportunity for wide ranges in scores, the resulting percentage marks on examinations are no longer restricted within the limits of 70 to 100 which previously represented nine-tenths of the pupil scores. The task, then, of translating into marks the examination scores and other pupil evaluations has become a problem of some significance to teachers.

In an effort to assist teachers in marking the Russell's Classroom Scaler and Grader has been constructed by Charles Russell and published by Ginn and Company, Boston, Massachusetts. To accept this instrument it is necessary to recognize certain assumptions inherent in its use. The teacher assumes that grades should be determined by the relative ranking of pupils with reference to the factors measured in the class. He also assumes that the percentage of pupils who should receive each grade on the scale can be decided by the teacher before consulting the device, or can be determined by the percentage of pupils classified in each level of intelligence by the mental-test scores received by the pupils in the class. Accepting these assumptions, the teacher arranges the pupils in order, decides the percentage to receive each grade, and then translates. These tables are an improvement over the method of grading which applies a normal curve directly to every class. Instead, the shape of the curve may be determined by the teacher's judgment or from the results of an intelligence test. The obvious question is the acceptability of these two assumptions. When they are acceptable, the Scaler will be found very helpful. The device provides a simple method for calculating achievement

ratios or effort scores. The assumption underlying such calculations is that the intelligence test indicates the ability which can be expected of pupils, the achievement evaluations measure the degree to which this ability is being realized, and differences indicate corresponding great or little effort.

For some of the tasks involved in assigning grades these tables will be very useful; however, it seems to the reviewer that the most significant problem to be met before grades can properly be assigned is the definition of the purpose and function of grades. It will then be possible to adopt with more certainty a procedure for assigning grades to pupils. The messy situation in which we find ourselves in attempting to determine how to give grades is largely due to this lack of definition of the purposes for which these grades are to serve. When these have been determined we are then ready to evolve a statistical technique by which to attain these purposes. Until such techniques are provided the Scaler will be of assistance in calculating grades.

THE Stewart-Ashbaugh Physics Test has been published recently by the Public School Publishing Company, Bloomington, Illinois. This test has been prepared for use in high-school physics classes and is divided into two parts; the first part covering mechanics and heat, the second part electricity, sound, and light. This represents the common division between the first- and second-semester topics in physics. Although the test is altogether too brief for diagnostic purposes, it contains two promising types of exercises. One type requires the student to explain specific phenomena in terms of certain general laws of physics. Another type calls for an understanding of the principles which account for the action of certain physical appliances. Unfortunately, no evidence is presented to indicate what other objectives the test measures nor whether the exercises were so chosen that they require the student to apply physical principles to situations new to him or whether these applications may have been memorized beforehand. The test is not reliable enough to be used as a single measure of achievement but may be used in combination with other evidences of accomplishment.

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